



BioCosmos / Foton

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NASA Ames Research Center

M. Skidmore (mskidmore@mail.arc.nasa.gov)



What Is BioCosmos



- > Russian free flying satellite series where the US has collaborated on 9 spaceflights since 1974.
- ➤ Variety of experimental models ranging from fungus to nonhuman primates.
- ➤ US flew as an invited guest during the first 8 flights (Cosmos series).
- ➤ Bion 11 was the first flight in the series conducted under contract
- > Launch from Plesetsk Cosmodrome on a "Soyuz" launcher
- Orbital parameters:
 - * 62.8° or 82.3° inclination
 - * Altitude 226 to 394 Km



BioCosmos Varients





SPACE-BASED SYSTEM BION-M (IN A VERNIER CONFIGURATION)

It is designed for carrying out fundamental and applied researches in field of space biology, radiobiology and radiophysics as well as effecting researches on a commercial basis.

Technical characteristics

Orbital parameters:

- · near-circular operational orbit with an average altitude
- inclination

S/C mass

Payload mass:

- · inside the reentry capsule
- · inside the S/C

Orbital lifetime

Type of flight

Daily average energy consumption

of the payload elements

Air temperature inside the reentry

capsule

Launch vehicle Launching site

Scientific data transmission to

the ground:

450 km 62.8°

6300 kg

up to 700 kg up to 200 kg

45 days nonoriented

135 W (at 45 days' flight)

Plesetsk

from +18° to +28°C "Soyuz"

- · via radio-telemetry and television channels to the receiving stations situated within the territory of Russia:
- · via TeleSupport system to the receiving stations situated in Sweden and Alaska
- · inside the reentry capsule when the soft landing takes place.

SRPSRC "TeSKB-PROGRESS"

SPACE-BASED SYSTEM BION-M

(IN A CHEMICAL BATTERY CONTAINER CONFIGURATION)

space biology, radiobiology and radiophysics as well as effecting researches on a commercial basis.



Technical characteristics

Orbital parameters:

- · minimum altitude
- · maximum altitude
- inclination

S/C mass

- Payload mass:
 - · inside the reentry capsule
 - · inside the S/C

Orbital lifetime

- Type of flight
- Daily average energy consumption
- of the payload elements

Air temperature inside the reentry capsule

Launch vehicle

Launching site

Scientific data transmission to

the ground:

226 km 394 km 62.8° 6300 kg

up to 700 kg up to 200 kg 45 days nonoriented

200 W (at 45 days' flight)

from +18° to +28° C "Soyuz" Plesetsk

- · via radio-telemetry and television channels to the receiving stations situated within the territory of Russia;
- · via TeleSupport system to the receiving stations situated in Sweden and Alaska:
- · inside the reentry capsule when the soft landing takes place.



Bion Space Vehicle



> Pros

- Proven design, successful history of Bion spaceflights
- Incremental improvement on basic design w/higher orbit & longer durations
- Science drives the mission: Studies requiring exposure to radiation, disease vectors, toxins are possible
- Less rigorous verification / validation / safety environment facilitates technology insertion







Cons

- Unproven 45 day duration
- NASA must commit to significant % of total mission costs
- Launch, landing at remote locations in Russia
- More rigorous shock / vibration environment



Foton Space Vehicle



- ➤ In the simplest terms Foton is Bion without a life support system but it has:
 - Higher power available to the payload (no LS system)
 - * Lower μG levels (range from 10-4 to 10-6)
 - Higher heat rejection capability (routinely carries furnaces)





40G for 10 msec Separation of **Battery Pack**



-Order From Configuration **Retro Rocket Fire** ?? Minutes @ ?? G

30 days On Orbit



10 minutes to orbit Peak ~ 3G



40G for 10 msec Separation of **Service Module**



Reentry Dynamics ?? Minutes Peak = ??G



40G for 10 msec **Parachute Deploy**



Bion "G" **Forces**





Nominal Landing Impact ?? G for ?? msec



Pre-Flight Timeline



L-48
Hours

Final Loading and checkout of Spacecraft. Last access to payload elements (vertical)



L-28 to L-19

L-19 to L-0

Rocket on lounch pad pre-lounch activities (vertical)

Spacecraft/ Rocket
Integration & rollout to pad
(horizontal)



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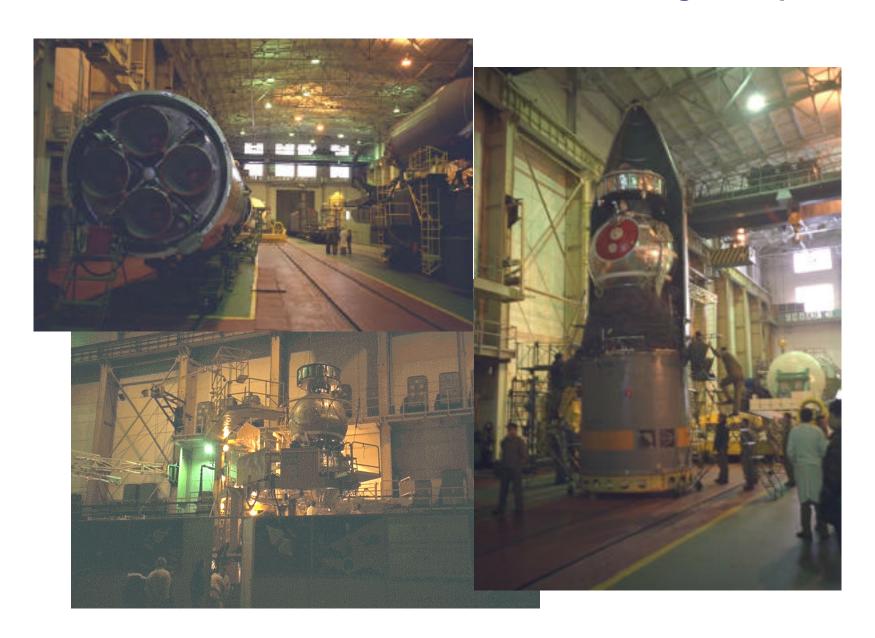
Launch from Plesetsk Cosmodrome

L-0

Hours



Bion 11 Pre-Flight Preparation





BioCosmos Operational Locations







Bion 11 Post-Flight Timeline



R+0 to R+24

Locate Spacecraft (orientation unknown)



~1-2 Hours Elapsed Time

Assemble inflatable tent around spacecraft and begin recovery operations (vertical) ~3-8 Hours ET

Recover payload - prepare for transport by helicopter



~8-13 Hours ET

Helicopter
transport to
nearby airport,
aircraft transport
to Moscow, Truck
/ van transport to
IMBP



POST-FLIGHT TIMELINE: For Bion 11, the total elapsed time from spacecraft landing to payload arrival at IMBP in Moscow was ~13 hours.

RECOVERY SITE OPERATIONS: The timeline for previous flights with rodents included dissection and other manipulations at the recovery site and/or at the town nearest to the recovery point.

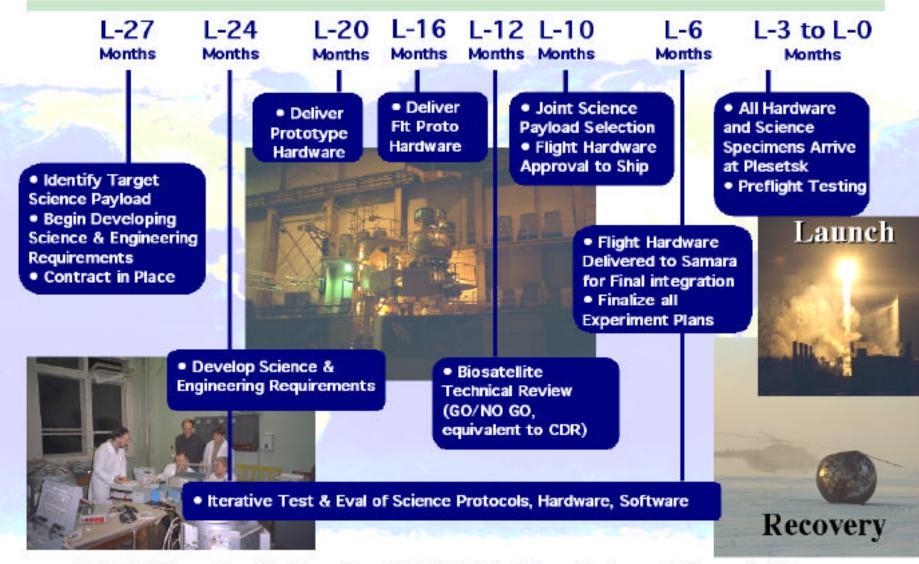
Bion 11 Post-Flight Recovery



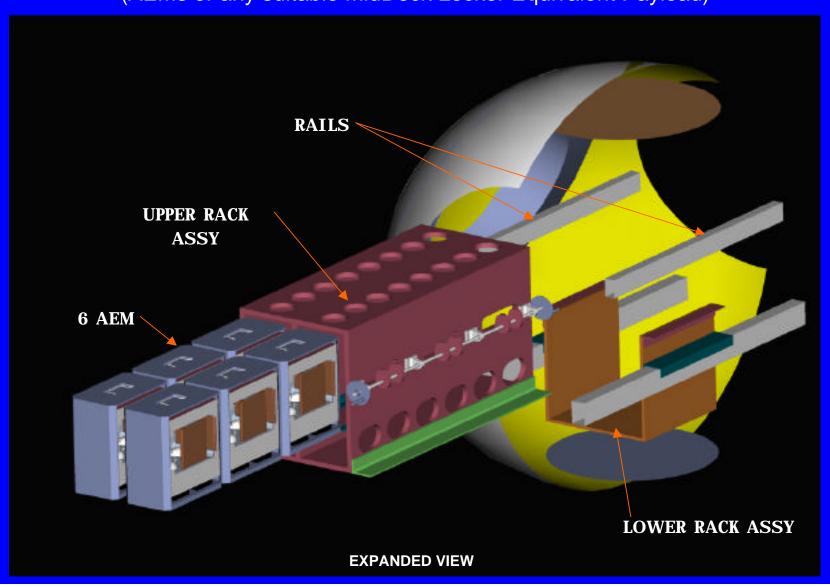


Hardware Development Flow on Bion





Scheme to Install 6 Animal Enclosure Modules onboard BioCosmos (AEMs or any suitable MidDeck Locker Equivalent Payload)









There are links from each of these sites that may also relevant

TsSKB- Progress; http://www.fas.org/spp/civil/russia/tsskb.htm

IMBP; http://www.imbp.ru/webpages/engl/welcom.html

Bion-M International Workshop; http://biosp.acvrb.ssau.ru/

Samara Space Center; http://www.starsem.com/soyuz/samara.htm

Soviet/Russian reconnaissance satellites; http://www.users.wineasy.se/svengrahn/histind/Recces/Recces.htm

Foton satellite; http://www.estec.esa.nl/spaceflight/foton/fsatlite.htm

Telescience Support Unit; http://www.ssc.se/ssd/tsuweb.html

Preparations in Samara for launching a Foton spacecraft from Plesetsk in early September 1999; http://www.users.wineasy.se/svengrahn/histind/Foton/Foton.htm

Cosmodrome Plesetsk; http://www.russianspaceweb.com/plesetsk.html

Foton 12: http://esapub.esrin.esa.it/bulletin/bullet101/baglioni.pdf